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Lake St. John, Hamlin County South Dakota

National Eutrophication Survey, Corvallis, Oreg

Prepared for

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REPORT
ON
LAKE ST. JOHN
HAMLIN COUNTY
SOUTH DAKOTA

EPA REGION VIII

WORKING PAPER No. 610

WITH THE COOPERATION OF THE

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENTAL PROTECTION

AND THE

SOUTH DAKOTA NATIONAL GUARD

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the South Dakota Departments of Environmental Protection and Game, Fish and Parks for professional involvement, to the South Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

Allyn Lockner, Secretary, and Blaine Barker and Duane Murphy, Department of Environmental Quality; Douglas Hansen, Department of Game, Fish and Parks; and James Hayden, Director, State Lakes Preservation Committee provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

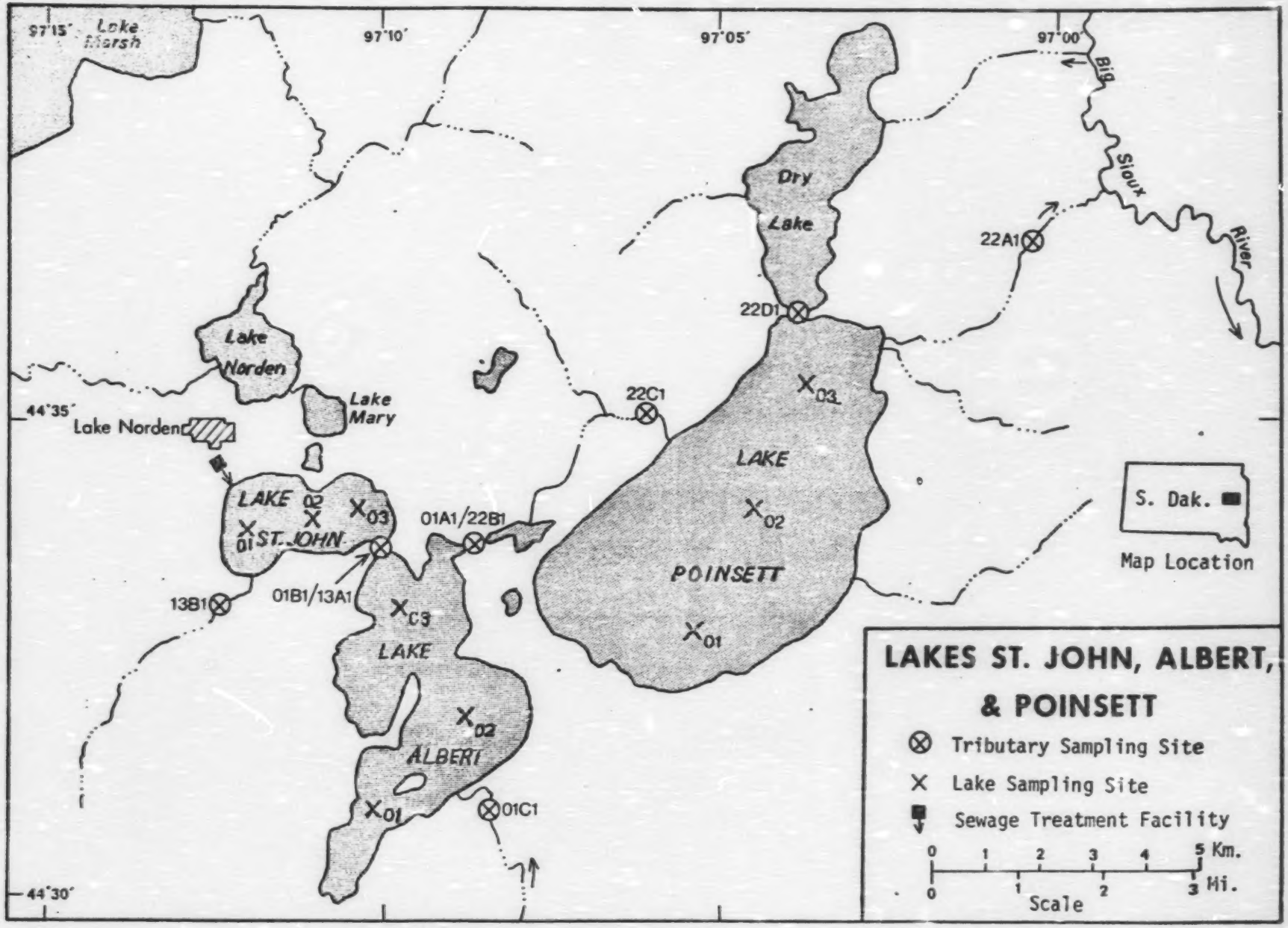
Major General Duane L. Corning, the Adjutant General of South Dakota, and Project Officer Colonel Robert D. Chalberg, who directed the volunteer efforts of the South Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF SOUTH DAKOTA

LAKE NAME	COUNTY
Albert	Kingsbury
Alvin	Lincoln
Angostura	Fall River
Brant	Lake
Byron	Beadle
Clear	Marshall
Clear	Minnehaha
Cochrane	Deuel
Cottonwood	Spink
Deerfield	Pennington
Enemy Swim	Day
Herman	Lake
John	Hamlin
Kampeska	Codington
Madison	Lake
Mitchell	Davidson
Norden	Hamlin
East Oakwood	Brookings
West Oakwood	Brookings
Pactola	Pennington
Pickerel	Day
Poinsett	Brookings, Lake
Red Iron South	Marshall
Richmond	Brown
Roy	Marshall
Sand	Brown
Sheridan	Pennington
Stockdale	Custer
East Vermillion	McCook
Wall	Minnehaha
Waubay	Day


97°15'
Lake Marsh
97°10'
97°05'
97°00'
Big Sioux River
Dry Lake
22A1
22D1
Lake Norden
Lake Mary
22C1
44°35'
Lake Norden
LAKE ST. JOHN
01
02
03
01A1/22B1
13B1
01B1/13A1
LAKE POINSETT
LAKE ALBERT
01C1
44°30'
S. Dak.
Map Location
LAKES ST. JOHN, ALBERT, & POINSETT
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale

LAKE ST. JOHN

STORET NO. 4613

I. INTRODUCTION

Due to low flow conditions, only a few outlet samples were collected. Therefore, this report relates only to the lake sampling data. However, the outlet and wastewater treatment plant effluent data obtained are included in Appendix E for the record.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake St. John is eutrophic. It ranked twenty-fourth in overall trophic quality when the 31 South Dakota lakes sampled in 1974 were compared using a combination of six water quality parameters*. Twenty-six of the lakes had less median total phosphorus, 17 had less median dissolved orthophosphorus, three had less and one had the same median inorganic nitrogen, 26 had less mean chlorophyll a, and 28 had less mean Secchi disc transparency.

Survey limnologists reported algal blooms in July and September.

B. Rate-Limiting Nutrient:

The algal assay results indicate that the lake was nitrogen limited in April and September. The lake data indicate nitrogen limitation at all sampling times.

* See Appendix A.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 4.86 kilometers^2.
2. Mean depth: 1.2 meters.
3. Maximum depth: 2.4 meters.
4. Volume: 5.832 x 10^6 m^3.
5. Mean hydraulic retention time: 2.9 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Creek B-1	23.3	0.009
Minor tributaries & immediate drainage -	422.5	0.057
Totals	445.8	0.066

2. Outlet -

Unnamed Creek A-1	450.7**	0.064

C. Precipitation***:

1. Year of sampling: 38.5 centimeters.
2. Mean annual: 60.0 centimeters.

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† Table of metric conversions--Appendix B.
†† Murphey, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

IV. LAKE WATER QUALITY SUMMARY

Lake St. John was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. The first time, a near-surface sample for physical and chemical parameters was collected from one station on the lake, and the latter two times, samples were collected from two depths at two stations (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was collected from the station(s) for phytoplankton identification and enumeration; and during the first and last visits, single 18.9-liter depth-integrated samples were collected for algal assays. Also each time, a depth-integrated sample was taken from each station sampled for chlorophyll a analysis. The maximum depths sampled were near-surface at station 1, 0.6 meters at stations 2, and 0.3 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR ST JOHN LAKE
STORET CODE 4613

PARAMETER	1ST SAMPLING (4/23/74) 1 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/12/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/20/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	8.2 - 8.2	8.2	8.2	24.5 - 24.8	24.6	24.6	16.1 - 16.1	16.1	16.1
DISS OXY (MG/L)	10.8 - 10.8	10.8	10.8	5.2 - 14.8	8.4	6.9	9.2 - 9.4	9.3	9.4
CNDCTVY (MCROMO)	567. - 567.	567.	567.	1392. - 1410.	1401.	1401.	1288. - 1290.	1289.	1289.
PH (STAND UNITS)	8.5 - 8.5	8.5	8.5	8.6 - 8.7	8.7	8.7	8.6 - 8.7	8.7	8.7
TOT ALK (MG/L)	185. - 185.	185.	185.	228. - 244.	234.	232.	172. - 178.	175.	175.
TOT P (MG/L)	0.245 - 0.245	0.245	0.245	0.348 - 0.418	0.397	0.410	0.316 - 0.387	0.338	0.325
ORTHO P (MG/L)	0.017 - 0.017	0.017	0.017	0.066 - 0.079	0.072	0.072	0.018 - 0.025	0.021	0.020
NO2+NO3 (MG/L)	0.040 - 0.040	0.040	0.040	0.060 - 0.109	0.085	0.090	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.040 - 0.040	0.040	0.040	0.080 - 0.110	0.092	0.090	0.030 - 0.040	0.037	0.040
KJEL N (MG/L)	2.200 - 2.200	2.200	2.200	2.600 - 3.300	2.950	2.950	4.800 - 5.100	4.925	4.900
INORG N (MG/L)	0.080 - 0.080	0.080	0.080	0.140 - 0.200	0.177	0.185	0.050 - 0.060	0.057	0.060
TOTAL N (MG/L)	2.240 - 2.240	2.240	2.240	2.700 - 3.390	3.035	3.025	4.820 - 5.120	4.945	4.920
CHLRPYL A (UG/L)	76.2 - 76.2	76.2	76.2	133.8 - 142.6	138.2	138.2	78.3 - 173.5	125.9	125.9
SECCHI (METERS)	0.2 - 0.2	0.2	0.2	0.2 - 0.3	0.3	0.3	0.3 - 0.3	0.3	0.3

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/23/74	1. Nitzschia sp.	58,421
	2. Flagellates	20,082
	3. Melosira sp.	10,155
	4. Ankistrodesmus sp.	6,276
	5. Stephanodiscus sp.	5,135
	Other genera	5,590
	Total	105,659
07/12/74	1. Melosira sp.	2,147
	2. Oocystis sp.	1,975
	3. Stephanodiscus sp.	1,632
	4. Scenedesmus sp.	1,374
	5. Microcystis sp.	1,288
	Other genera	8,585
	Total	17,001
09/20/74	1. Oscillatoria sp.	44,767
	2. Binuclearia sp.	4,277
	3. Closterium sp.	3,422
	4. Coelosphaerium sp.	3,279
	5. Melosira sp.	2,709
	Other genera	15,541
	Total	73,995

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/23/74	1	76.2
	2	-
	3	-
07/12/74	1	-
	2	142.6
	3	133.8
09/20/74	1	-
	2	78.3
	3	173.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.075	0.048	4.0
0.050 P	0.125	0.048	3.9
0.050 P + 1.0 N	0.125	1.048	30.1
1.0 N	0.075	1.048	28.0

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.110	0.454	15.2
0.050 P	0.160	0.454	17.5
0.050 P + 1.0 N	0.160	1.454	35.5
1.0 N	0.110	1.454	36.7

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Lake St. John was high at the times the assay samples were collected (04/23/74 and 09/20/74). Also, significant increases in yield with the addition of nitrogen alone indicate that the lake was limited by nitrogen at those times. Note that the addition of phosphorus alone did not result in significantly increased yields.

The lake data also indicate nitrogen limitation; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 5/1 or less on all sampling occasions.

V. LITERATURE REVIEWED

Murphey, Duane G., 1974. Personal communication (lake morphometry). SD Dept. of Env. Prot., Pierre.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
4601	LAKE ALBERT	0.321	0.170	489.111	106.289	9.200	0.019
4602	ALVIN LAKE	0.067	0.970	442.833	4.700	9.400	0.017
4603	ANGOSTURA RESERVOIR	0.019	0.160	423.333	3.717	13.000	0.005
4604	BRANT LAKE	0.194	0.130	432.833	34.150	11.800	0.113
4605	LAKE BYRON	0.443	0.370	488.333	149.350	9.000	0.146
4606	CLEAR LAKE	0.027	0.075	430.167	11.983	8.800	0.009
4607	CLEAR LAKE	1.400	0.270	495.333	691.000	7.000	0.468
4608	COCHRANE LAKE	0.037	0.150	446.000	15.683	15.000	0.008
4609	COTTONWOOD LAKE	0.685	0.265	490.333	112.017	8.600	0.417
4610	DEERFIELD RESERVOIR	0.033	0.080	303.333	3.650	15.000	0.022
4611	ENEMY SWIM LAKE	0.037	0.085	442.600	14.200	8.200	0.013
4612	LAKE HERMAN	0.340	0.155	485.000	58.733	8.600	0.174
4613	ST JOHN LAKE	0.348	0.080	489.400	120.880	9.800	0.025
4614	LAKE KAMPESKA	0.220	0.105	468.889	20.567	8.200	0.128
4615	MADISON LAKE	0.250	0.090	445.555	22.578	14.000	0.107
4616	LAKE MITCHELL	0.099	0.085	465.833	14.883	13.800	0.015
4617	LAKE NORDEN	0.256	0.165	488.667	46.800	10.000	0.050
4618	OAKWOOD LAKE EAST	0.146	0.175	487.000	113.600	10.000	0.009
4619	OAKWOOD LAKE WEST	0.181	0.135	485.833	159.667	9.600	0.021
4620	PACTOLA RESERVOIR	0.011	0.070	248.444	1.478	11.000	0.006
4621	PICKEREL LAKE	0.049	0.095	439.833	15.833	9.600	0.009
4622	LAKE POINSETT	0.115	0.315	468.444	40.211	10.000	0.023
4623	LAKE RED IRON SOUTH	0.042	0.110	430.333	6.883	7.600	0.010
4624	RICHMOND LAKE	0.187	0.150	410.000	18.467	10.000	0.144
4625	ROY LAKE	0.034	0.070	431.000	13.333	11.000	0.010
4626	SAND LAKE	0.489	0.110	471.800	65.790	12.800	0.288
4627	SHERIDAN LAKE	0.053	0.105	394.000	15.433	15.000	0.016
4628	STOCKADE LAKE	0.233	0.150	432.000	25.400	15.000	0.109

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
4629	LAKE VERMILLION	0.211	0.100	472.833	100.800	9.200	0.092
4630	WALL LAKE	0.194	0.160	441.667	55.267	7.400	0.076
4631	WAUBAY LAKE NORTH	0.098	0.145	469.555	127.033	11.400	0.023

10

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
4601	LAKE ALBERT	20 (6)	20 (6)	10 (3)	23 (7)	68 (20)	60 (18)	201
4602	ALVIN LAKE	67 (20)	0 (0)	57 (17)	90 (27)	63 (19)	63 (19)	340
4603	ANGOSTURA RESERVOIR	97 (29)	30 (9)	87 (26)	93 (28)	20 (6)	100 (30)	427
4604	BRANT LAKE	40 (12)	53 (16)	70 (21)	47 (14)	27 (8)	23 (7)	260
4605	LAKE BYRON	10 (3)	3 (1)	17 (5)	7 (2)	73 (22)	13 (4)	123
4606	CLEAR LAKE	93 (28)	93 (28)	83 (25)	83 (25)	77 (23)	90 (27)	519
4607	CLEAR LAKE	0 (0)	10 (3)	0 (0)	0 (0)	100 (30)	0 (0)	110
4608	COCHRANE LAKE	83 (25)	40 (11)	50 (15)	67 (20)	5 (0)	93 (28)	338
4609	COTTONWOOD LAKE	3 (1)	13 (4)	3 (1)	20 (6)	82 (24)	3 (1)	124
4610	DEERFIELD RESERVOIR	90 (27)	88 (26)	97 (29)	97 (29)	5 (0)	53 (16)	430
4611	ENEMY SWIM LAKE	80 (24)	82 (24)	60 (18)	77 (23)	88 (26)	73 (22)	460
4612	LAKE HERMAN	17 (5)	33 (10)	27 (8)	33 (10)	82 (24)	10 (3)	202
4613	ST JOHN LAKE	13 (4)	88 (26)	7 (2)	13 (4)	53 (16)	43 (13)	217
4614	LAKE KAMPESKA	33 (10)	65 (19)	40 (12)	57 (17)	88 (26)	20 (6)	303
4615	MADISON LAKE	27 (8)	77 (23)	53 (16)	53 (16)	13 (4)	30 (9)	253
4616	LAKE MITCHELL	60 (18)	82 (24)	47 (14)	73 (22)	17 (5)	70 (21)	349
4617	LAKE NORDEN	23 (7)	23 (7)	13 (4)	40 (12)	45 (12)	40 (12)	184
4618	OAKWOOD LAKE EAST	53 (16)	17 (5)	20 (6)	17 (5)	45 (12)	85 (25)	237
4619	OAKWOOD LAKE WEST	50 (15)	50 (15)	23 (7)	3 (1)	58 (17)	57 (17)	241
4620	PACTOLA RESERVOIR	100 (30)	98 (29)	100 (30)	100 (30)	35 (10)	97 (29)	530
4621	PICKEREL LAKE	73 (22)	73 (22)	67 (20)	63 (19)	58 (17)	85 (25)	419
4622	LAKE POINSETT	57 (17)	7 (2)	43 (13)	43 (13)	45 (12)	47 (14)	242
4623	LAKE RED IRON SOUTH	77 (23)	58 (17)	80 (24)	87 (26)	93 (28)	78 (23)	473
4624	RICHMOND LAKE	47 (14)	40 (11)	90 (27)	60 (18)	45 (12)	17 (5)	299
4625	ROY LAKE	87 (26)	98 (29)	77 (23)	80 (24)	35 (10)	78 (23)	455
4626	SAND LAKE	7 (2)	58 (17)	33 (10)	30 (9)	23 (7)	7 (2)	158
4627	SHERIDAN LAKE	70 (21)	65 (19)	93 (28)	70 (21)	5 (0)	67 (20)	370
4628	STOCKADE LAKE	30 (9)	40 (11)	73 (22)	50 (15)	5 (0)	27 (8)	225

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
4629	LAKE VERMILLION	37 (11)	70 (21)	30 (9)	27 (8)	68 (20)	33 (10)	265
4630	WALL LAKE	43 (13)	27 (8)	63 (19)	37 (11)	97 (29)	37 (11)	304
4631	WAUBAY LAKE NORTH	63 (19)	47 (14)	37 (11)	10 (3)	30 (9)	50 (15)	237

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4620	PACTOLA RESERVOIR	530
2	4606	CLEAR LAKE	519
3	4623	LAKE RED IRON SOUTH	473
4	4611	ENEMY SWIM LAKE	460
5	4625	ROY LAKE	455
6	4610	DEERFIELD RESERVOIR	430
7	4603	ANGOSTURA RESERVOIR	427
8	4621	PICKEREL LAKE	419
9	4627	SHERIDAN LAKE	370
10	4616	LAKE MITCHELL	349
11	4602	ALVIN LAKE	340
12	4608	COCHRANE LAKE	338
13	4630	WALL LAKE	304
14	4614	LAKE KAMPESKA	303
15	4624	RICHMOND LAKE	299
16	4629	LAKE VERMILLION	265
17	4604	BRANT LAKE	260
18	4615	MADISON LAKE	253
19	4622	LAKE POINSETT	242
20	4619	OAKWOOD LAKE WEST	241
21	4631	WAUBAY LAKE NORTH	237
22	4618	OAKWOOD LAKE EAST	237
23	4628	STOCKADE LAKE	225
24	4613	ST JOHN LAKE	217
25	4612	LAKE HERMAN	202
26	4601	LAKE ALBERT	201
27	4617	LAKE NORDEN	184
28	4626	SAND LAKE	158

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	4609	COTTONWOOD LAKE	124
30	4605	LAKE BYRON	123
31	4607	CLEAR LAKE	110

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR SOUTH DAKOTA 05/03/76

LAKE CODE 4613 ST. JOHN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 450.7

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4613A1	450.7	0.0	0.0	0.142	0.283	0.142	0.085	0.057	0.028	0.028	0.0	0.0	0.0	0.064
4613B1	23.3	0.0	0.0	0.0	0.057	0.028	0.028	0.0	0.0	0.0	0.0	0.0	0.0	0.009
4613ZZ	427.3	0.0	0.0	0.142	0.255	0.113	0.057	0.057	0.028	0.028	0.0	0.0	0.0	0.057

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 450.7
SUM OF SUB-DRAINAGE AREAS = 450.7
TOTAL FLOW IN = 0.79
TOTAL FLOW OUT = 0.76

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4613A1	10	74	0.0	12	0.0				
	11	74	0.0	6	0.0				
	12	74	0.0	1	0.0				
	1	75	0.0	19	0.0				
	2	75	0.0	23	0.0				
	3	75	0.0	9	0.0				
	4	75	0.006	13	0.003				
	5	75	0.003	3	0.003	18	0.003		
	6	75	0.0	7	0.0	19	0.0		
	7	75	0.0	20	0.0				
	8	75	0.0	17	0.0				
	9	75	0.0	21	0.0				
4613B1	10	74	0.0	12	0.0				
	11	74	0.0	10	0.0				
	12	74	0.0	1	0.0				
	1	75	0.0	19	0.0				
	2	75	0.0	23	0.0				
	3	75	0.0	9	0.0				
	4	75	0.0	13	0.0				
	5	75	0.0	3	0.0				
	6	75	0.0	7	0.0	19	0.0		
	7	75	0.0	20	0.0				
	8	75	0.0	17	0.0				
	9	75	0.0	21	0.0				

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APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/05/03

461301
44 34 00.0 097 13 15.0 4
ST JOHN LAKE
46057 SOUTH DAKOTA

090791

11EPALES 2111202
0005 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO26NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/23	13 30	0000	8.2	10.8	9	567	8.55	185	0.040	2.200	0.040	0.017

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/23	13 30	0000	0.245	76.2	

20

STORET RETRIEVAL DATE 76/05/03

461302
44 33 54.0 097 12 00.0 3
ST JOHN L KE
46 SOUTH DAKOTA

090791

11EPALES 2111202
0004 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/12	11 15	0000	24.5	14.8	8	1392	8.70	228	0.110	3.000	0.090	0.066
	11 15	0001	24.5	5.2		1392	8.70	228	0.090	3.300	0.090	0.079
74/09/20	11 20	0000	16.1	9.4	12	1288	8.68	175	0.040	4.800	0.020K	0.018
	11 20	0002	16.1	9.2		1288	8.68	172	0.030	5.100	0.020K	0.025

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/12	11 30	0000	0.348	142.6	
	11 30	0001	0.408		1.0
74/09/20	11 00	0000	0.316	78.3	
	11 00	0001	0.317		
	11 00	0002			1.0

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K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/05/03

461303
44 34 00.0 097 10 05.0 3
ST JOHN LAKE
46057 SOUTH DAKOTA

11EPALES 2111202
0004 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/12	11 30	0000	24.8	7.8	12	1410	8.70	236	0.090	2.600	0.100	0.068
	11 30	0001	24.8	6.0		1410	8.60	244	0.080	2.900	0.060	0.076
74/09/20	11 00	0000	16.1	9.4	12	1290	8.64	175	0.040	4.900	0.020	0.021
	11 00	0001	16.1			1290	8.64	178	0.040	4.900	0.020K	0.019

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/12	11 15	0000	0.413	133.8	
	11 15	0001	0.418		1.0
74/09/20	11 20	0000	0.334	173.5	
	11 20	0002	0.387		1.0

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K VALUE KNOWN TO BE LESS THAN INDICATED

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/05/04

4613A1
44 33 30.0 097 10 10.0 4
UNNAMED CH _K
46 7.5 LAKE NORDEN
0/LAKE ST JOHN 090791
BRDG ON SEC RD 2 MI S OF JCT WITH HWY 28
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/04/13	09 45		19.800	3.800	1.450	0.360	0.440
75/05/03	14 25		0.010	3.450	0.055	0.040	0.160
75/05/18	10 30		0.015	3.900	0.110	0.010	0.110
75/06/07	14 45		0.020	3.150	0.080	0.020	0.120
75/06/19	20 20		0.005	3.500	0.055	0.020	0.110
75/06/22	13 30		0.005	3.700	0.075	0.050	0.140

HC

STORET RETRIEVAL DATE 76/05/04

461321 PD461321 P000393
44 34 30.0 097 12 15.0 4
LAKE NORDEN
46 7.5 LAKE NORDEN
D/LAKE ST. JOHN 090791
LAKE ST. JOHN
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/01/06	15	30	0.080	26.000	10.500	3.700	21.000		
75/05/01			0.050						
75/07/08	08	15	0.025	11.000	2.350	2.100	10.800	0.125	0.125
75/07/24			0.025	15.000	0.140	4.400	9.000	0.125	0.125
75/11/02	14	15	0.025	22.000	0.100	10.500	18.000		

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